Trends And Opportunities In Semiconductor Licensing

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Summary

The following article examines the impact of current business, technology, and international trends in the semiconductor industry, and anticipates future challenges and opportunities for intellectual property licensing in this market. The working team brought to bear many decades of work experience in different parts of the semiconductor business to illustrate relevant topics from a business, technical and legal perspective, which are required disciplines to formulate and execute comprehensive intellectual property strategies and execute successful licensing programs. This paper does not attempt to describe every development in detail, but provides pointers for further study by interested readers.

I. Semiconductor Industry and Business Trends

The Semiconductor Industry is Maturing

The semiconductor industry is a diverse industry that has grown tremendously over the past several decades as integrated circuits (IC) have penetrated virtually all aspects of people's lives: computers, communication systems, consumer goods, and cars, to name a few. In the 1960s and 1970s, the market was driven by military and mainframe applications. In the 1980s, the PC revolution took over, and in the 1990s, the explosive growth of the Internet and mobile communications became the market's main driving force. Since the year 2000, continued expansion of all these markets, plus increasing penetration into other new product categories—such as digital TVs, mobile phones, and all types of other smart devices—have become new growth engines. However, as the semiconductor industry exceeded $300B in annual sales for the first time in 2010, the rate of growth has slowed from high double digits in the early years, to about 13 percent on average during the 1990s and about 8 percent since 2000.[1] While new applications continue to arise and be addressed, the market will continue to mature, and the growth rate will slowly moderate toward world GDP growth, which has averaged 3.4 percent since 1980.[2] The semiconductor industry remains a market of discrete sub-markets though, where some market segments still show high growth, but at a macro level this is offset by lower growth in other segments. For example, ICs for smart phones are still showing strong growth rates, while the desktop PC market has been stagnating. Other segments, such as the DRAM memory market, have shown significant cyclicality in the past, alternating between periods of strong positive and negative growth. This dynamic has been based on the undifferentiated, commodity nature of the DRAM products, combined with cycles of demand for increased DRAM in PCs and other devices. Due to these factors, the number of DRAM producers has been reduced through M&A transactions and business exits from about 20 in 1995[3] to only three

1. WSTS statistics: *http://www.wsts.org/Teaser-Left/Historical-Billings-Report.*

2. IMF World Economic Outlook database: *http://www.imf.org/external/pubs/ft/weo/2013/01/weodata/index.aspx.*

3. A Study of the DRAM industry: *http://dspace.mit.edu/bitstream/handle/1721.1/59138/659514510.pdf.*

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majors by 2013 (Samsung, SK Hynix, and Micron). In such competitive segments and other such commodity markets, chip suppliers often lack pricing power, resulting in pressure to reduce their costs and those of their suppliers, including IP suppliers and licensors.

Semiconductor companies are classified as either integrated device manufacturers (IDM) that own their own fabrication facilities (*e.g.* Intel, Samsung), or as fabless semiconductor companies (*e.g.* Qualcomm, Broadcom, nVidia) that contract their device manufacturing to third party foundries like TSMC or Global Foundries. Many former IDM's such as Freescale, STMicroelectronics, Fujitsu, and others have been adopting a hybrid model—often referred to as "fab-lite"—over the past decade. In this model, companies maintain some of their own fabs, often for specialty devices, while they outsource much of their advanced process capacity needs to foundries. In addition to semiconductor ICs or components, related markets in the semiconductor ecosystem include foundry fabrication services, processing equipment, IC design tools, semiconductor intellectual property, and semiconductor materials.

Figures 1 to 3 show breakdowns of semiconductor sales by end application, geographic region, and device type respectively as reported by IHS/ISuppli.[4] Figure 2 shows that 57 percent of the roughly $300B in semiconductor sales were first made to companies in the Asia-Pacific region, excluding Japan. The vast

Figure 1. Major Markets By Application[4]

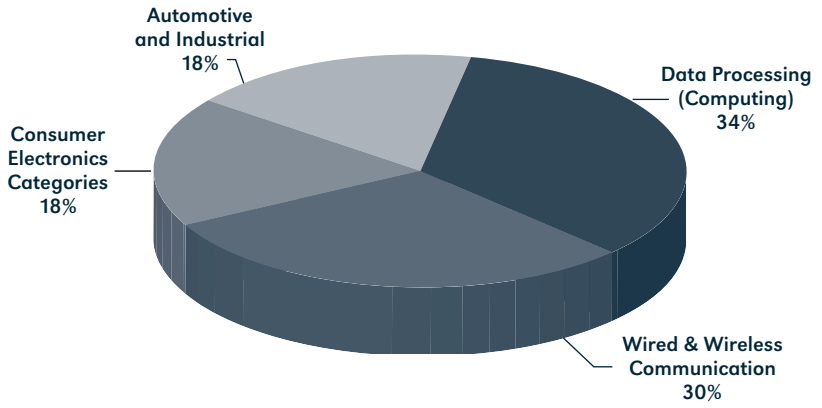


Figure 2. Regional Sales Distribution[4]

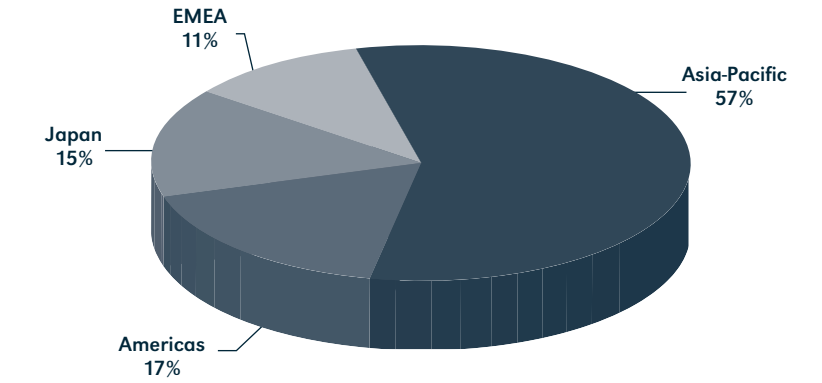
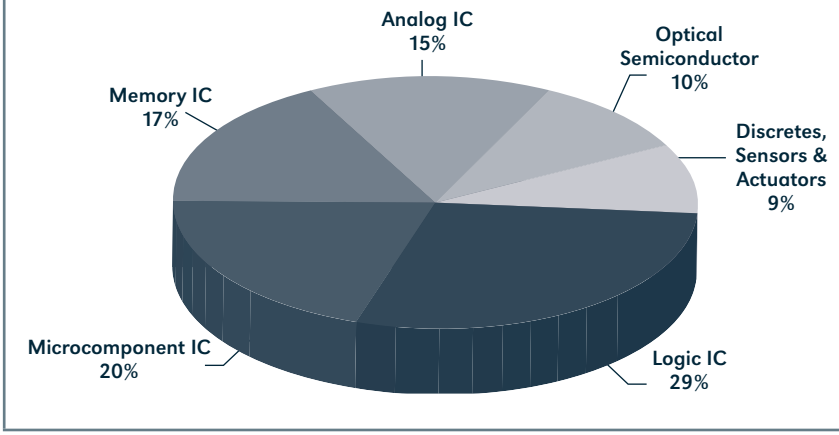


Figure 3. Major Device Categories[4]

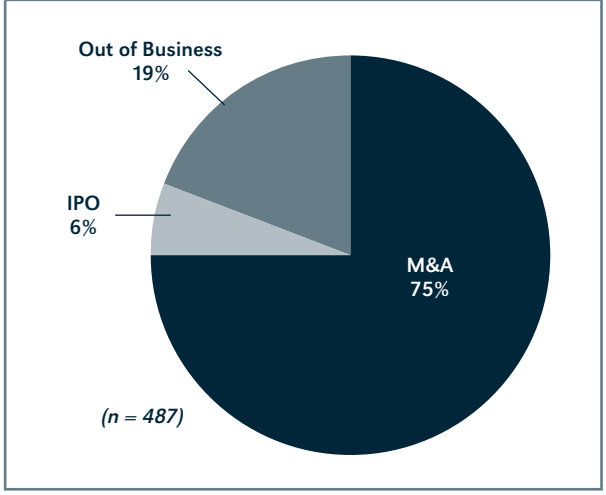


4. IHS iSuppli Competitive Landscaping Tool, 2013.

majority of these sales were in the People's Republic of China (PRC), where a large part of electronics manufacturing is done by so called contract manufacturing companies like Hon-Hai (Foxconn), Flextronics, and others.

Starting a new semiconductor company, even in a fabless model, has become increasingly expensive, with typical investments now ranging between 10 million to well over 100 million dollars,[5] depending on the complexity of the chip development and the nature of its end market. At the same time, the number of successful semiconductor IPOs in the United States and EMEA has been shrinking since the late 1990s, while there has been higher activity in Asia, mostly in China and Taiwan. The pie chart in Figure 4 shows that only 6 percent of semiconductor exits between 2002 and 2011 were IPOs, while the vast majority of exits (75 percent) were mergers or acquisitions.

Figure 4. Semiconductor Exits From 2002-2011[6]

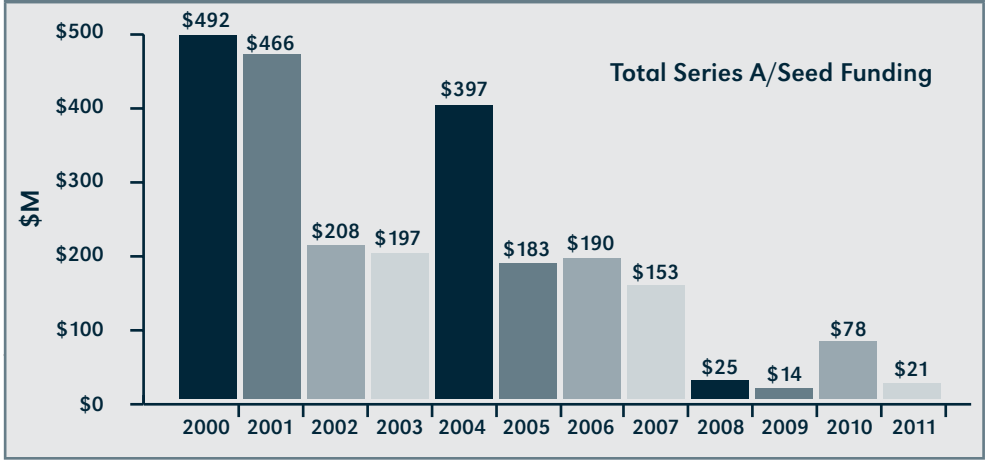


M&A activity has partly compensated for less buoyant public markets, but M&A valuations are generally lower than public market valuations. This, in combination with the increasing capital requirements for start-ups, has caused a reduction in (venture) capital investments into early-stage semiconductor companies as shown in Figure 5, and has resulted in fewer startups being created. Over the long term, this dynamic will result in more concentration of chip supply.

While the two largest semiconductor companies,[8] Intel and Samsung, have grown market share over the past two decades, the top 20 chip makers' combined market share has actually declined from about 75 percent in 1990 to 65 percent by 2010.[9] While this trend, at a first glance, appears counter intuitive, it was at least, in part, enabled by the emergence of the foundry and fabless semiconductor model during the 1990s, which permitted new entrants into the field without the need for massive capital spending to build their own fabrication facilities. Going forward however, consolidation is expected to continue, as fewer new companies enter the market and existing ones get acquired by larger established companies.

To mitigate the immense costs of developing and introducing new technologies, even for established

Figure 5. Early Stage Semiconductor Venture Funding From 2000-2011[7]



5. How to raise seed investments for a hardware startup: *http://sktainnopartners.com/how-to-raise-seed-investments-for-a-hardware-startup/.*

6. Pagemill Partners Study in GSA Capital Lite Business Model: *http://www.gsaglobal.org/wp-content/uploads/2012/10/Capital_Lite_Report_2012.pdf.*

7. GSA Capital Lite Business Model: *http://www.gsaglobal.org/wp-content/uploads/2012/10/Capital_Lite_Report_2012.pdf.*

8. Top 25 2012 Semiconductor Supplier Ranking: *http://www.icinsights.com/news/bulletins/PurePlay-Foundries-And-Fabless-Suppliers-Are-Star-Performers-In-Top-25-2012-Semiconductor-Supplier-Ranking/.*

9. The Semiconductor Top 20: *http://www.lithoguru.com/scientist/SemiTop20.html.*

semiconductor companies, various consortia have grown in importance. Consortia established to share the cost of technology developments such as EUV, (extreme ultraviolet) 450mm wafers, or sub 10nm process technologies, including the Center for Semiconductor Research at the State University of New York, ITRI in Taiwan, IMEC in Belgium, and the Institute of Microelectronics in Singapore. It remains to be seen whether such consortia will be able to effectively sustain the level of innovation required to propel the industry forward and to provide the requisite intellectual property for the successful development of new market opportunities.

Intellectual Property (IP) Licensing in the Semiconductor Business

With millions or even billions of transistors, today's ICs often integrate dozens of different functions, and practice tens of thousands of patented inventions. The value of this IP needs to be priced into the cost of goods for these devices, but the low target price points for consumer devices and the number of functions embodied, can cause pressure on royalty rates and the license fees customers are willing and able to pay for each function.

Licensing has a long tradition in the semiconductor business, including process/technology licensing, patent licensing—which can include cross licensing—and more recently, design IP licensing. This dynamic has been driven by the complexity of chip development and manufacture and the myriad talents and inputs required to make increasingly complex semiconductors. As chip designs continue to grow in complexity, the need for licensing IP to address capability gaps and accelerate time-to-market will be reinforced.

In addition to third-party design IP suppliers (*e.g.* ARM, Synopsys, etc.), several semiconductor companies have also started licensing their design IP to others for integration into SoC (system on chip) designs as more functions that used to be standalone chips become features in those devices. Examples include various types of interface functions, such as Ethernet, HDMI, or even complex blocks like processor cores and GPUs offered by IBM and nVidia. This licensing approach can yield cashflow to offset other development and licensing costs for the licensor semiconductor company.

Design IP business models generally use some combination of upfront license fees, re-use fees, support fees, and running royalties to generate revenues back to the licensor. The market size for design IP is largely based on the number of design starts, license fees associated with these new designs, and the unit volumes for each design start, which drive royalty revenues. The total design IP market in 2012 was about $2B,[10] or less than 1 percent of total semiconductor sales, but it is projected to continue growing faster than the industry, at over 10 percent CAGR (compound annual growth rate). Larger licensing companies are trying to consolidate more IP blocks into their product lines to provide more of a one-stop shop and capture a larger share of the market.

Over time, many semiconductor companies have started patent licensing campaigns to license or cross-license certain competitors, and also to monetize their substantial IP holdings by licensing companies in adjacent markets. Some early pioneers in this field include Texas Instruments[11] and IBM,[12] who both generated billions of dollars from licensing their vast patent portfolios to competitors. More recent examples of companies pursuing this strategy include Qualcomm, Micron, and Sandisk who have embarked on licensing programs or have partnered with licensing companies to monetize their extensive patent portfolios.

Based on a more sophisticated assessment of how much IP is 'enough' for the defense of their core products and markets, divestitures of non-core patents have created an active patent market over the past decade.[13] This market was further fueled by a number of semiconductor startups from the late 1990s and early 2000s which have begun selling or licensing their patent portfolios to liquidate the business or to generate cash for expansion. These trends will likely continue for a while, but with fewer startups being created, activity of that type will likely be decreasing over time.

With more companies monetizing their patent portfolios, a stagnating number of larger potential licensees, and a trend toward weaker patent enforcement, at least in the United States, there is price pressure on royalty rates and license fees. While the chip suppliers may continue to consolidate to improve their competitive position in terms of cost

10. Synopsys, Imagination make gains in semi IP ranking; *http://www.eetimes.com/document.asp?doc_id=1280825.*

11. Patents, Standards, and Licensing Working (Well) Together at Texas Instruments; *http://www2.aipla.org/html/mw/2010/papers/Bassuk_Paper.pdf.*

12. IBM's Patent/Licensing Connection; *http://www.industryweek.com/product-development/ibms-patentlicensing-connection.*

13. Turning the Spotlight on the Brokered Patent Market; *http://www.iam-magazine.com/blog/detail.aspx?g=1e58b1bc-0a55-4ce6-8741-b874495dd9e2.*

of manufacture and negotiating position with their end customers, such consolidation will likely have an adverse impact on IP suppliers and licensors of these chip suppliers as their potential licensees are gaining more buying power.

II. Semiconductor Technology Trends

The semiconductor industry is one of the most knowledge and technology intensive industries.[14] Some of the vast array of technological developments in this field, and their impact on industry licensing activity, will be highlighted here. As more complex technologies and designs are developed, which generally generate more patented inventions, the result is the generation of more patent licensing activity.

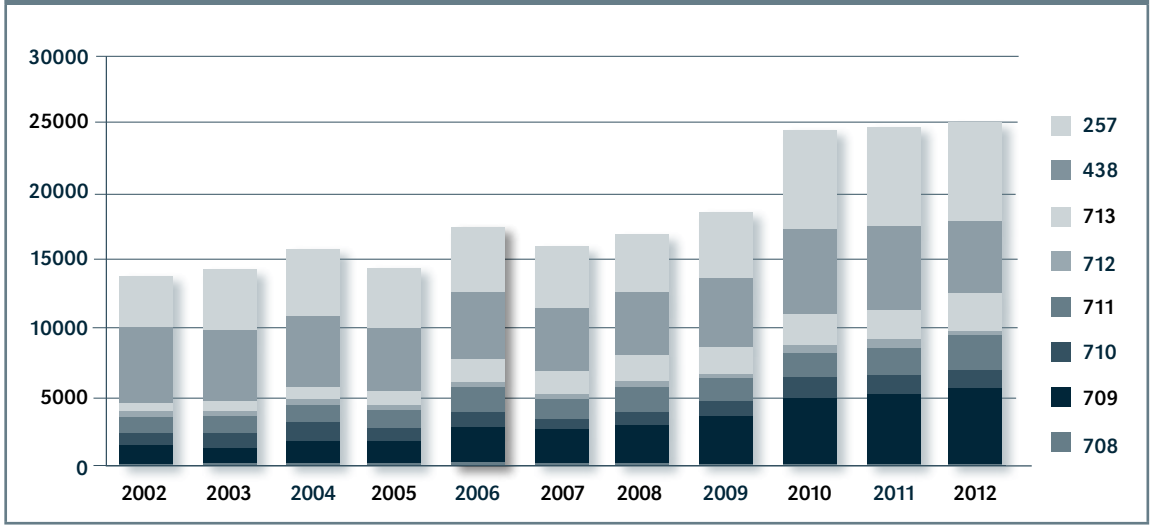
Figure 6 displays a count of U.S. patents issued with class codes[16] representative of the semiconductor industry. The class codes represent the patents' primary technology areas determined by the PTO. One significant observation is the near 50 percent jump in issued patents between 2009 and 2010. While the PTO has reduced the average pendency period from about 38 months in 2009 to about 30 months today, the continued high numbers in 2011 and 2012 indicate that the patent issuance jump was not caused solely by the PTO's efficiency improvements, but also from sustained patenting activity in the technology space. One might surmise from Figure 6 that the industry has increased its focus on obtaining patents and has acknowledged the business value of the intellectual property produced.

For conventional silicon-based semiconductor ICs, the industry is still driving to increase performance while reducing cost/size/power consumption of the transistor at the rate established by Moore's law.[17] However, the implementation of the latest semiconductor process nodes at 20 nm and below requires the investment of billions of dollars due to rising fab costs, which makes it the domain of large established companies with the ability, resources, and scale to conduct the necessary development. While it is unlikely that start-ups will secure the resources to fund implementation of process nodes beyond 20 nm, their efforts could still result in the next incremental improvement or an entirely disruptive technology. The transition to mass production will likely require some type of partnership and transfer of IP between the inventors and large companies.

Disruptive Opportunities Through Revolutionary Technologies Still Exist

Key technology is being developed in support of next generation silicon technologies and the developers usually strive to protect their inventions by obtaining relevant IP rights. Expected to be commercialized after 2015, some significant developments include the move to extreme ultraviolet (EUV) providing lithography at 13.5 nm wavelength, and the move to

Figure 6. U.S. Patents by Class Code Issued from 2002-2012[15]



14. NSF: Science and Engineering Indicators, Ch. 4: *http://www.nsf.gov/statistics/seind12/.*

15. Source: U.S.P.T.O.

16. 257 - relates to Active Solid State Devices; 438–Semiconductor Device Manufacturing; 709–Electrical Computers and Digital Processing Systems.

17. Moore's Law and Intel Innovation: *http://www.intel.com/content/www/us/en/history/museum-gordon-moore-law.html.*

450 mm wafers. Another significant development, which started over a decade ago and has begun entering mass production recently, is the transition to 3D transistors (*e.g.* FinFETs) from planar CMOS devices which will be necessary for future process nodes. These disruptive technologies, along with earlier innovations such as Hi-K metal gate (HKMG) technology, are extending the continuous scaling of devices following Moore's law. FinFET manufacturing is now being more broadly adopted for devices like mobile application processors and is likely to result in major changes to the process flow, equipment, electronic design automation, IP, and design methodology.

In the memory market, primarily consisting of DRAM and Flash memory, major technology transitions are on the horizon as scaling of legacy technologies is becoming harder and harder. New memory technologies, expected to enable continued density increases and cost reductions, include 3D Flash, Resistive RAM, and STT-MRAM. Other technologies, such as phase change memory, ferromagnetic memory, and optical storage are under development as well. As evident, there are many technology options and there are no clear winners at this point.

Another innovative segment that has shown significant growth is micro electro-mechanical systems (MEMS) technology for applications such as gyroscopes, accelerometers, microphones, and pressure sensors. MEMS can be built using many of the same established silicon processes, which have been an area of active patenting during the last decade. The MEMS sector grew another 10 percent to become an $11B business in 2012 and analysts expect a 12-13 percent CAGR through 2018 to create a $22.5B MEMS market.[18]

Beyond silicon, there are significant IP developments in organic semiconductors (OTFTs, OLEDs, and polymer solar cells), LEDs for lighting applications, solar PV cells, gallium nitride (GaN) and silicon carbide (SiC for high power applications, and GaN for RF and mm-wave applications). Additional examples of technologies still under development include graphene transistors and amorphous silicon transistors (on flexible plastic substrates). Nanostructures may find their way into semiconductors in the form of carbon-nanotubes, quantum dots, and nano-wires.

New application areas include millimeter-wave imaging, 60 GHz RF transceivers, very low power circuits for portable and battery-less systems (such as sensors), and energy harvesting circuits. Performance per watt is starting to replace performance per dollar as a key metric in many applications.

In the device fabrication and packaging area, the trend is to achieve further size reductions by 2.5D and 3D stacking, thru silicon vias (TSV), silicon interposers, and wafer level chip scale packaging. Integration of multifunctional devices enabled by 3D interconnect is expected to bring increased performance and functionality along with cost reductions. In addition, the SEMATECH Forum has been promoting 3D Interconnect Standards Development. As a result, adoption of 3D integration is rapidly spreading to a wide variety of companies across the semiconductor and MEMS industries. The massive investments required to commercialize new disruptive technologies opens up opportunities for licensing of technology and patented inventions in these new areas.

Implications for Licensing

Specialization/Outsourcing of IP Blocks

Modern system-on-chips (SoCs) and field-programmable gate array (FPGA) devices allow, and for many applications require, the integration of many system functions, combined with substantial amounts of firmware, embedded software, and even complete operating systems. Developing this functionality all from scratch is too costly and slow even for companies that have all the necessary skillsets in-house. As stated earlier, this force has helped to create the $2B+ design intellectual property market over the past two decades and is continuing to drive it. Design IP allows SoC designs to be constructed using pre-qualified hardware blocks known as intellectual property IP cores and software modules known as software IP blocks. Negotiating and managing licensing agreements with the various IP suppliers and tracking the IP usage and compliance with such licenses across large corporations with many end products, represents a formidable challenge. As a result, novel IP licensing schemes are being proposed. In one example, a pay-per-use licensing scheme is proposed for IP cores in which a third party runs a metering service to monitor use.[19]

For third party patent holders that seek to monetize their patented technologies, this provides a range of licensing opportunities. For example, if a particular IP core is implemented in a number of SoCs from different suppliers, a third party patent holder may have

18. Yole Developement: *http://www.yole.fr/*.

19. Roel Maes, Dries Schellenkens, and Ingrid Verbauwhede, "A Pay-per-Use Licensing Scheme for Hardware IP Cores in Recent SRAM-Based FPGAs", IEEE Transaction On Information Forensics And Security, Vol. 7, No. 1, February 2012.

a choice as to whether to sign a licensing agreement with the IP core provider, with each SoC supplier integrating the core, or even with the system companies using the SoCs with those cores in their products. Choosing the optimal licensing strategy depends on a number of factors, including the geographic coverage of the patents relative to the location where products are manufactured, sold, or used.

Detectability of Patented Technologies

The detection of patented technologies in the semiconductor industry poses ever-increasing challenges. The shrinking feature sizes of modern semiconductor fabrication processes require more advanced analysis tools circuit detection/extraction. As feature sizes are reaching the limits of existing imaging capabilities, new technologies will have to be developed. In addition, the distance between the different layers of metallization is also decreasing, thereby driving the need for more complex delayering techniques for exposing the various layers of circuitry within an IC. As more SoC functionality is being implemented in software, software reverse engineering is now commonly used to investigate the functionality of SoCs. Software reverse engineering adds yet another level of complexity and also requires a completely different skill set for analysis. Public access to decompiled code is rare and in most cases requires code extraction from a working device, decompression, and then decompiling of the code. This entire process is complex and costly with a substantial risk of failure. The level of risk is exacerbated by the fact that protective measures, such as removal of ASCII characters in the code and encryption, are increasingly used to prevent reverse engineering of the software.

The added challenges in detecting patented technologies have a direct impact on licensing activities and on the value of patent portfolios. Patents claiming subject matter that is too difficult and/or cost-prohibitive to detect are much less attractive and may not provide much licensing value.

Patent Protection for Software

With the increasing shift of development effort from hardware to software, appropriate software protection must become an integral part of IP strategies. When considering licensing opportunities, a major concern is the ability to enforce IP rights. While still evolving, the current level of patent protection for software varies from one country to another, and in some cases protection is limited or not available at all. This limits the ability to enforce software IP and can diminish the relative IP protection of semiconductor devices that have substantial software content.

Ecosystem Complexities

The semiconductor supply chain ecosystem is complex and globally dispersed and many semiconductor companies serve the same system customers and use the same suppliers for their manufacturing, equipment, tools, and design IP needs. These relationships add complexity to licensing agreements as companies desire to gain license coverage that includes their suppliers, customers, and affiliates. As a result, licenses or covenants may be granted to cover intermediaries (*e.g.* retailers, wholesalers, distributors, dealers, resellers, importers, and exporters) or suppliers (*e.g.* foundries, contractors, assembly and test facilities etc.). Any licensor needs to carefully consider the trade-offs of providing upstream and downstream coverage in a license agreement to not inadvertently license much more of the market than intended or meaning within the economic parameters of a given transaction. A further complicating factor is the evolving law around patent exhaustion, injunctions, and other rights and remedies. This makes patent licensing complex and mandates detailed planning for any licensing campaign to make sure that it can accomplish its strategic objectives.

Managing the Cost of IP

Methods used to manage intellectual property and its related costs vary widely. Considering the investment in research to develop a technology and the costs of securing and maintaining patents in multiple countries, it becomes critical for companies to gain a deep understanding of their patent portfolio, and how it generates business value. It is not uncommon for a single patent family with multiple international filings and continuations to generate lifetime costs well in excess of $100,000. Selecting and executing appropriate international filing strategies, aligned with business objectives, thus is another critical element of IP strategies.

IP-savvy companies manage their portfolios by understanding the technical and business value of individual patents, building portfolios around strategic technologies and searching externally for complementary IP to strengthen these portfolios. Such a portfolio approach entails the scoring of patents on various criteria to identify the patents that are most valuable and relevant to the company's business strategy. High-value patents with high relevance to business objectives should be actively developed in all important geographic markets. Patents that do not align with business objectives can be sold or aban-

doned to manage maintenance expenses. There are a number of tools and consultants that have developed proprietary patent valuation methods, which can help evaluate and classify a portfolio. These techniques can also be used to identify areas of vulnerability, where identified third party patents may be acquired to fill the gaps.

III. International Trends

Since the invention of the transistor and later, the integrated circuit, the United States has been a leader in semiconductor development and manufacturing. Over time however, other regions such as Europe, Japan, and more recently, Taiwan, South Korea, and China have developed substantial semiconductor design and manufacturing capabilities. While India has attracted many IC design centers, the country has not yet developed a significant manufacturing base for either semiconductors or electronics.

The broad availability of the process of discovery, well-developed statutes and jurisprudence, comparatively high damages awards, and a large market make the United States a favored country for patent enforcement. However, the changing geographic distribution and economics of semiconductor device manufacturing, packaging and their assembly into finished products has had and will continue to have substantial impacts on the protection and enforcement strategies for semiconductor related intellectual property rights.

There are significant differences in the legal systems and IP protections afforded in other countries compared to the United States, including licensing and enforcement regulations and practices. If a company intends to engage in licensing outside of the United States, it has to ensure that the licensed technologies are backed up by patents, trademarks, copyrights, and applicable intellectual/industrial property rights in these countries.

While the United States is still one of the major electronics markets, its relative importance decreases as emerging markets continue to expand. The trend towards non-U.S. manufacturing of semiconductors and electronics also continues. Although there have been a few instances of electronic product assembly moving back the United States,[20] the vast majority of such assembly remains outside the country. A typical IC might be manufactured in a foundry in Taiwan or the People's Republic of China, packaged in Malaysia, the Philippines, or the PRC and then assembled into a final product in the PRC. Such semiconductors may then enter the United States incorporated into such a final product or perhaps never even enter the country.

Although a lawsuit in a U.S. district court or a proceeding before the U.S. International Trade Commission against the importer of the final product may be legally possible, for patents owned by a semiconductor manufacturer, the importer's market power as a potential or actual customer may make such enforcement economically impossible. Consequently, assertion against a competitor in other countries would be preferable, but not always practical, given the wide range of IP protection available around the world. A growing number of semiconductor manufacturers and research entities have the economic power to insist that the laws of their own country govern any agreement, and that any dispute be resolved before the courts of their country.

Entities whose business consists of asserting patents may not be subject to the market power of an importer. However, some entities license know-how or non-patent intellectual property in addition to patents. For those "value-added" licensing entities, the party to whom they can add the greatest value may be semiconductor manufacturers. This may make importers a less appropriate licensee. Naturally, this will depend, among other factors, on the relative value of the patents versus know-how and other intellectual property.

While these economic and geographic trends may not be specific to semiconductors, they are certainly highly relevant here due to the complex global nature of the semiconductor supply and value chains. These trends increase the importance of filing, licensing, and enforcing intellectual property in key semiconductor manufacturing and consuming countries. As intellectual property rights in other countries have grown in importance, companies need to actively monitor the legal and regulatory developments in those regions. Below is a summary of a number of recent changes in key countries collected from practitioners in each of the markets.

People's Republic of China (PRC)

From 2003 to 2011, China's share of the worldwide semiconductor consumption market has grown from less than 19 percent to over 47 percent.[21] This makes the country the biggest geographic market.

20. Moto X: First U.S.-Made Smartphone Just as Cheap to Produce as Others: *http://techland.time.com/2013/08/28/moto-x-first-u-s-made-smartphone-just-as-cheap-to-produce-as-others/.*

21. China's impact on the semiconductor industry: 2012 update: *http://www.pwc.com/gx/en/technology/chinas-impact-on-semiconductor-industry/download-the-report.jhtml.*

While over 60 percent of these semiconductors are still assembled into goods for export, the domestic market has been rapidly growing at a CAGR of 24 percent since 2003 and it now represents about 20 percent of the worldwide total. Even though there are now over 500 indigenous IC design companies in China (about 30 of which are publicly listed) the market is still dominated by global players led by Intel and Samsung. Combined, the top-10 international suppliers represent about 45 percent of the market and no Chinese company has made it into the top-35 suppliers yet.

In the PRC, a recent trend has been toward bolstering the interim remedies available to patent owners and the evidence preservation mechanisms. Matthew Laight, who practices in Bird & Bird LLP's Hong Kong office, indicated that the 2012 amendments to the Civil Procedure Law allow a party to seek an evidence or asset preservation order before filing a court action. The pre-action evidence preservation order is useful where there is a risk that evidence may be destroyed if the defendant becomes aware of the lawsuit. The pre-action asset preservation order may be important in dealing with smaller entities and in the case of counterfeit or diverted semiconductor products. It may be less important against large alleged infringers with substantial assets. Laight also reported that the 2010 amendments to the Patent Law clarified the procedure for the grant of a preliminary injunction, and codified evidence preservation laws. He believes that these amendments will benefit patent owners. Due to the lack of discovery in PRC civil litigation, damages can be difficult to prove, and damages fixed by statute are often awarded. These statutory damages have been doubled, from RMB 500,000 to RMB 1,000,000 (about US$ 150,000). Although likely to be viewed as a step in the right direction by patent owners, the impact of such increased damages on semiconductor IP strategy may be limited.

Taiwan

TSMC remains the major force in the Taiwanese semiconductor industry, and combined with UMC represents over 50 percent of the global foundry market that is fueling fabless semiconductor companies. While TSMC and MediaTek, the largest domestic fabless company, have shown significant growth recently, other parts of the Taiwanese industry have struggled, exemplified by the dwindling number of local DRAM companies, and some of the smaller fabless companies with a focus on the PC market.[22] However, Taiwan's semiconductor industry remains well positioned to benefit from the continued expansion of the Chinese market; its broad established base of design houses and manufacturing companies; and the level of government support.

In Taiwan, the low enforcement success rate of patent owners since the 2008 creation of a dedicated IP court may be addressed by a complete revision of patent law taking effect in 2013 and new regulations from the Taiwan Intellectual Property Office. Yu-Lan Kuo of Formosa Transnational Attorneys at Law reports that patent owners will be permitted to correct claims by incorporating features described in the specification to clarify the meaning of the existing claims. This opportunity to alter claims in the midst of a court proceeding could substantially increase a patent owner's odds of successful enforcement. Up until this year, if a single claim in a Taiwan patent was found to be invalid during an invalidation action, the entire patent became invalid. This was changed so that only the invalidated claims are invalidated. In addition, corrections to translation errors are now permitted. This will be of particular importance to the owners of patents first filed in another language. All of these changes should serve to improve patent owners' odds of successful enforcement. These changes seem likely to make it more attractive to file and enforce patents in Taiwan for all intellectual property owners, including those working in semiconductor technology. Kuo also commented that Taiwan's semiconductor companies have become much more sophisticated in dealing with intellectual property, adding that they have become much more proactive in patent filing, prosecution, and licensing.

It is interesting to note that Taiwan is undertaking reforms to address the issue of poorly translated patents. Because of the economics of patent prosecution and the tight budget to which prosecutors are often held, it is highly likely that translation errors are a common problem in other countries as well. Any entity filing for patents, including any entity filing for semiconductor patents, would be well served to monitor the quality of its foreign filings.

Japan

In the late 1980s, half of the top-20 semiconductor companies were Japanese, including the top three in 1989.[23] Fast forward to the year 2012, and only five Japanese companies are listed in the top-20, the

22. Taiwan semiconductor industry undergoing structural shift: *http://www.pwc.tw/en/challenges/industry-trends/industry-trends-20120924.jhtml.*

23. Semiconductor sales leaders by year: *http://en.wikipedia.org/wiki/Semiconductor_sales_leaders_by_year.*

biggest in fifth rank. This illustrates the tremendous change and consolidation the industry has gone through over the past two decades, a process that is still in play, as evidenced by the recent bankruptcy of Elpida Memory and near-bankruptcy of Renesas Electronics. The industry has been slowly adopting fab-lite business models and several companies have also started monetizing their substantial IP portfolios through licensing campaigns, partnerships, and divestitures. As manufacturing of consumer electronics, mobile phones, and PCs has shifted to China, Japanese companies faced tough competition from Taiwanese and South Korean semiconductor competitors. As a result, Japanese chip makers have been looking for new markets better aligned with their domestic industrial base, such as automotive, industrial, medical, and new energy applications.

Some have argued that litigation in Japan is biased against the patent holder.[24] Possibly in response to this perception, Japan amended a number of aspects of its patent law effective in 2012.[25] Previously, if a non-exclusive license to patents was not registered with the Japan Patent Office (JPO), the license would not have effect against third parties. If a patent covered by an unregistered license was transferred to a third party, the third party could assert that patent against the licensee. JPO reported that the system for registering non-exclusive licenses had been "scarcely utilized," and under the amendments, non-exclusive patent licenses will now remain in effect even without registration. However, the laws for the registration of exclusive licenses remained unchanged.

Other changes include a new procedure for transferring patents granted to one party to a joint development agreement to the other party, when that agreement provided it should be granted to the other party. Previously, there was a procedure to invalidate a patent granted to a party who was not the rightful owner, but not to transfer it. In addition, there were a number of procedural changes to coordinate the invalidity proceedings that could take place before the JPO and the trial court. Among other things, these changes were intended to prevent the patent owner from transferring a proceeding back and forth between the JPO and the IP High Court.

Although not specific to semiconductors, these changes may be of particular importance to the semiconductor industry. The increased protection for licensees may make licensing in IP blocks more attractive, and strengthen trends for the outsourcing of those IP blocks that are already present in the semiconductor industry. Because of the increasing expense of developing IP for semiconductors, the existence of laws providing for the transfer of IP developed under a JDA (joint development agreement) to the rightful owner may make such collaboration more attractive.

South Korea

While there are a number of smaller semiconductor companies, the South Korean semiconductor industry[26] today is dominated by Samsung Electronics and SK Hynix, which ranked number two and seven globally in 2012. These two companies represent over 60 percent of the global DRAM and over 40 percent of the NAND Flash market and are expected to maintain their strengths in these areas while they branch out into other segments, such as the foundry services offered by Samsung. Korea has long been a net payer of IP-related royalties,[27] and is attempting to shrink this imbalance through the creation of a government backed patent investment fund[28] that would aggregate and license patents to international companies. This idea has also gained traction in Japan, Taiwan, China, and also in Europe.[29]

According to Byeongmo Lee, a South Korean patent attorney, the Korea Fair Trade Commission published the"Review Guidelines on Unfair Intellectual Property Rights" in 2010. These guidelines make the following practices, amongst others, subject to possible review: markedly unreasonable royalty rates; refusal to license; limits on trade volume, territory, or duration and other restrictions that are unjust; limits on who can purchase a licensed good; and restrictions on the price of licensed products. Lee also reported that in in 2012 the Korea Fair Trade Commission published the "Guidelines for Fair Patent License Agreements," under which practices subject to review included imposition of disadvantageous terms on a party to a license that had an inferior bargaining position and causing a party to a license to misunderstand the license terms or the relevant patent. Lee indicated that the Korea Fair Trade Commission also issued the

24. "Is Japan a Hostile Environment for Patents," by Masahiro Samejima, *Intellectual Asset Management,* January/February 2010.

25. *Japan Patent Office Annual Report 2011*, Part 2.

26. Korea Semiconductor Industry Association: *http://www.ksia.or.kr.*

27. Royalties Paid Overseas Hit Record High: *http://www.koreatimes.co.kr/www/news/biz/2013/05/123_55104.html.*

28. Inside Asia's patent funds, *Intellectual Asset Management Magazine,* July/August 2012.

29. New rivals for Apple and Google in patent fight: South Korea and France: *http://www.mercurynews.com/ci_22831761/new-rivals-apple-and-google-patent-fight-south.*

"Model Operating Guidelines for Standard Setting Organizations for Voluntary Compliance" with the Monopoly Regulation and Fair Trade Act in 2012. The publication of these three guidelines may be a move toward a more proactive role for the Fair Trade Commission. Semiconductor companies licensing intellectual property that may have an impact on the Korean market should consider these guidelines in drafting their agreements. David Hunjoon Kim, from the YOU ME Patent & Law Firm located in Seoul, Korea, reports that he has observed an increase in the selection of arbitration as a means for dispute resolution. This may make settling any dispute arising under a license quicker and more efficient. In addition, Kim reports that from the beginning of this year, eight Korean banks have begun allowing their borrowers to use intellectual property portfolios as collateral, which may provide a new source of financing for entities whose primary asset is intellectual property. Because of this change, Mr. Kim expects to see an increase in the purchase and licensing of intellectual property portfolios. The impact of this trend on semiconductor enforcement and licensing may be to give smaller companies financing to help realize the value of their intellectual property.

Europe

The most visible semiconductor European semiconductor companies are STMicrolectronics, Infineon Technologies, and NXP Semiconductors, who have lost 30 percent global market share in the last six years,[30] not counting the 2009 demise of Qimonda, Europe's last remaining DRAM company. However, there are a number of smaller specialized firms addressing markets like automotive, industrial, and medical applications with diverse products such as power electronics, analog ICs, and MEMS products. Global Foundries maintains the biggest foundry operation in Europe, but there are several other smaller mixed signal foundries as well, such as X-fab, LFoundry, and others.[31]

Europe increasingly builds on the (IPR) Enforcement Directive 2004/48/EC according to Alexander Duisberg of Bird & Bird LLP's Munich office. He indicates that although the (IPR) Enforcement Directive's full impact is difficult to assess at this time, the frequency at which the procedural changes have been implemented in the civil law country courts is increasing. The (IPR) Enforcement Directive, once the court practice has been more broadly developed, has the potential to cause European countries to provide more timely court proceedings for IP cases, stronger IP enforcement, and to increase IP owner's access to evidence of infringement and to interlocutory injunctions. Duisberg also indicated that he has observed a gradual increase in the use of alternative dispute resolution in contracts, including license agreements. Duisberg stated that in his experience, "mediation has proven a very powerful tool in many situations where parties have reached a dead-lock and are hesitant to go to court."

Strategic Recommendations

Many of the economic and legal changes described for countries in the Asia Pacific region have the potential to strengthen the enforceability of intellectual property rights. In response to this trend, and the continuing growth of semiconductor-related activities in Asia, companies should consider increasing their patent filings in that region. The graph in Figure 7 would suggest that such a shift is already taking place.

In preparing the chart, data on patent applications by technology was not available from WIPO. Patent application publications were selected instead of patent grants, because applications may be abandoned after publication but before grant, therefore patent application publication data provides a better measure of patent filing activity. As is clear from the graph, the rate of semiconductor patent application publication has grown at the most rapid pace in the PRC and Korea. Although the United States has seen a four-fold increase in semiconductor patent application publication, and has the second highest rate, its rate of increase has not been nearly as great as for the PRC and Korea. Although the growth rate of patents from Europe and Japan has not kept pace with those of the PRC or Korea, or even the United States, Japan remains the country in which the most semiconductor patent applications are published.

As always, the relative proportions of patent filings or acquisitions in each country must be customized for the particular needs of the patent filer or acquirer. The usual issues of limited budgets, investment time frame, and location of manufacturers and markets continue to apply. However, it has become even more important for patent owners to anticipate against whom and where they are likely to enforce their patents. A non-practicing entity may decide on a different proportion between United States and international patent filings than a semiconductor manufacturer whose customers import finished products into the country.

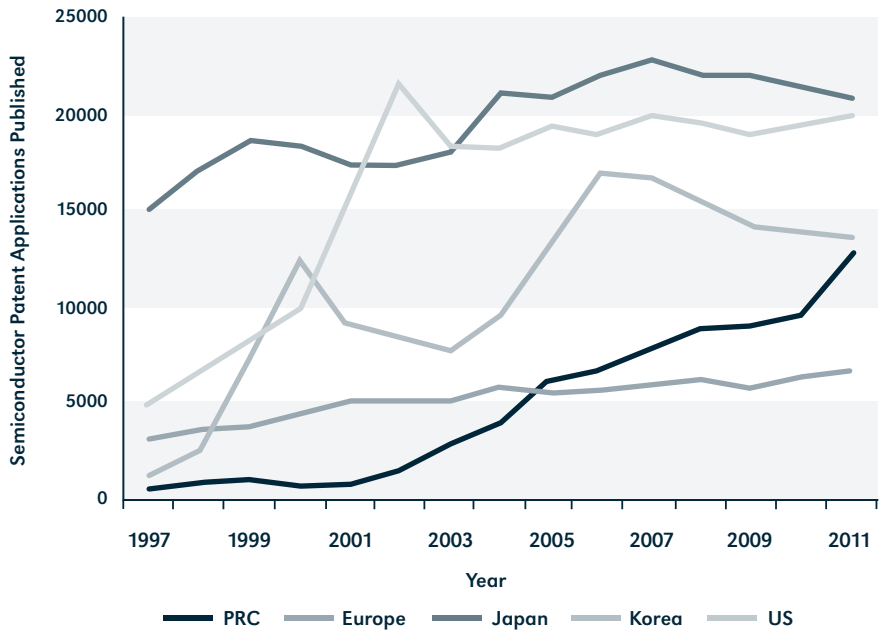
Business

All indications are that the amount of licensing in

30. Profile: European semiconductor industry: *Public Service Review: Europe*, Issue 25, 16 April 2013.

31. Semiconductor Industry Leaders Contemplate Region's Future at ISS Europe 2013: *http://www.semi.org/en/node/44966.*

Figure 7. Published Semiconductor Patent Applications By Country From 1997-2011[32]



the semiconductor industry will likely continue to increase over time, driven by the growing complexity of the chips and embedded software, rising R&D costs, the greater number of parties who seek to extract licensing revenues from such chip development activity, as well as the growing sophistication of the licensing parties in extracting returns from their IP.

As the semiconductor industry's growth keeps moderating toward world GDP growth rates, there will be downward pressure on royalty rates or settlement amounts associated with the licensing or cross-licensing of IP. For patent licensing, this trend could further accelerate if the enforcement regime in the United States or other major geographies such as the European union would be weakened. To counter this type of price erosion, licensing companies need to improve their offerings and provide more IP value to their customers, whether in form of broader design IP offerings or larger and stronger patent portfolios.

Regulatory changes, judicial action, and economic shifts in manufacturing centers—relative to product end markets—may impact the way licenses are being structured, but the fundamental need for licensing at all levels will remain. In addition, having the appropriate infrastructure to ensure compliance with such license agreements will continue to be important for any semiconductor company.

The development of industry-sponsored patent aggregators is an example of a preemptive method for mitigation of assertion risks. Traditional patent pools like MPEG-LA have been complemented by joint licensing programs, and more recently, by subscription based or one-by-one aggregation schemes such as provided by RPX or AST. Companies should take a more proactive stance to secure key IP that can provide bargaining power during licensing negotiations and thus help to counter assertion risks and ensure freedom to operate.

Technology

With the increased patenting activity, organizations will have a challenge carving out attractive technology positions solely using internal resources and will increasingly need to work with third parties to gain access to developing technologies. Concepts like "Open Innovation"[33] and "Want-Find-Get-Manage"[34] are approaches that may be useful to organizations for leveraging third party technologies as part of their innovation process. Patent search tools continue to develop and enable analysts to understand and identify organizations that are leading the development of certain technologies, as well as identify potential competitors or licensees. Improved search tools combined with patent valuation techniques allow the mining of patent portfolios of national labs and universities. Companies can use that data to license patents that complement internal innovation or to engage organizations which may be practicing a particular technology.

32. World Intellectual Property Organization IP Statistics Data Center: *http://ipstatsdb.wipo.org/ipstatv2/ipstats/patentsSearch; data obtained on September 15, 2013.*

33. *http://www.openinnovation.net/.*

34. Good Practices In Open Innovation: *http://www.iriweb.org/Public_Site/RTM/free/Good_Practices_in_Open_Innovation.aspx.*

With a shift towards a greater proportion of software contributing to functionality of end products, it is becoming more important to consider where technology will be implemented and used given the different level of software patent protection from one country to another. This can have an important impact on the decision to patent and license certain technologies. However, with software playing an increasingly important role, the IP community will be asked to provide adequate IP protection for software related inventions. As such, patenting software related inventions continues to be important and should be considered as part of comprehensive IP strategies.

Although detectability of patented technology in the semiconductor industry is increasingly challenging, new methodologies are continually being developed and the testing and the reverse engineering industry continues to flourish. However, it is important to understand and consider the level of difficulty and cost involved in detecting evidence-of-use for technologies when pursuing patent protection.

International

With the changes that are occurring in the geographic distribution of semiconductor activity, as well as frequent changes in U.S. and international patent law, portfolio development strategies need to be continuously evaluated and refined to effectively support business objectives. Working with experienced practitioners in each relevant region for business and legal advice will inform decision making and allow companies to capitalize on opportunities while minimizing risks.

With any cross-border licensing transaction, the parties need to agree on what country's laws will control and how and where any disputes will be resolved. Even if the parties agree on U.S. law with disputes resolved within the country's court system, pitfalls may remain. Treaties providing for enforcement of foreign court decisions do not exist among all countries, and even where they exist, in some countries the provisions of those treaties may be enforced in unexpected ways.

As more large companies in the semiconductor value chain are scattered around the globe, bigger players gain leverage to demand that the laws and courts of their own country govern licensing transactions. Companies without experienced country-specific in-house legal and IP resources should seek the advice of local counsel. Although obtaining such advice could add to the cost and time required for a transaction, it can help avoid unexpected outcomes in the future.

Conclusions

The semiconductor industry has a long history of IP licensing activities and remains a hotbed of activity. This article has outlined some of the challenges and opportunities facing companies in this evolving landscape. Exciting opportunities result from the increased integration of more functionality into and on top of semiconductor products, *e.g.* in the form of firmware or software. New disruptive technologies continue to emerge, along with new geographic markets and companies based in those markets. Changes in the economic, legislative and political environment have to be carefully tracked given the importance of IP and the long lead times to develop high-value portfolios. Companies both large and small have to constantly evaluate and adjust their intellectual property strategies to stay relevant and benefit from these developments. ■